THE TELEGRAPHIC JOURNAL AND ELECTRICAL REVIEW.

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THE THEORY OF ELECTRIC LIGHTING.

THE electric light has now been established on such a firm basis that any doubts which may previously have existed with regard to its chances of success have entirely died away. But although the practical progress has been great, the laws upon which a correct calculation of the economy of the light must be based seem as far from being understood or discovered as ever. This is partly due, no doubt, to the fact that practical men are seldom good mathematicians, and whilst they can form a rough estimate of the value of the performance of any particular machine or lamp in which they are interested, they fail to see in what way any variation from the existing order of things tends to affect the economy of the work performed.

It is almost impossible to see in what way the various elements which constitute the laws governing the action of dynamo machines affect one another without a good knowledge of mathematics.

The only method by which fair comparisons can be made between various machines without somewhat complicated mathematical investigations being introduced, is by working each machine under exactly the same conditions.

The question of efficiency as regards light produced is but very little affected by the class of lamp employed. Every arc lamp, no matter by what mechanism it is regulated, practically gives the same amount of light for a given current. It is in the dynamo machine that the question chiefly lies.

Up to the present time no single satisfactory trial of various machines has yet been made, principally because machines of a different class have been entered into competition one against the other. If any satisfactory results are to be obtained it would be by trying the various types of machine, *each wound to the same resistance*, and then with a given horse-power to determine the amount of current generated by each machine. To try a high resistance machine of one type against a low resistance machine of another type is, in our opinion, to render any comparison quite erroneous. The question of high *versus* low resistance is one thing, the question of the form of the inducing and induced magnets and of the bobbins is another question; the two should be tried quite independently, otherwise no satisfactory result will be arrived at. If the mathematical law governing the action of the machines were understood, results obtained from various machines could be reduced to a standard, but at present this seems out of the question.

As regards lamps, the question of arc *versus* incandescence can only be fairly settled by determining with a given current what amount of light is obtained with the two systems; but here again the standard of illumination would require to be fixed—at present it is in a most unsatisfactory state; the ordinary photometric measurements in candle power are liable to great error and misconstruction. There can be little doubt but that the factor of "space illuminated" requires to be taken into consideration in making calculations, and this as yet has not been done.

A good deal of information would be arrived at, with regard to the economy of the electric light, if the measurements of the currents, &c., were made in an intelligent and straightforward manner. Many of the measurements given in trials are, we believe, but little more than guesses at the truth, and are very far from the latter.

As an example of careful and intelligent methods of measurement, we would point out those described in an article on "The Brush system of electric lighting," in a recent number of our contemporary, *Engineering*. The substitution method is here employed for determining the resistance of the lamps, and a balance method for determining the potential of the current. Perhaps the best method of measuring the current strength in a circuit is that of including in the latter a resistance of a definite and known value, such as one ohm, and then measuring the potential between the two ends of the latter by connecting to them a galvanometer having a high resistance in its circuit; in this case the deflection obtained, compared with the deflection from a standard electromotive force inserted in the place of the one ohm resistance, gives at once, and accurately, the potential between the two ends of the latter, and this potential, divided by the resistance, gives correctly the strength of the current. It seems curious that this simple and accurate method is not adopted, instead of employing a tangent galvanometer, which at best is not a satisfactory instrument. The measurement of the current is one of the most important factors in determining the efficiency of a dynamo machine, and it is important that it be measured correctly. But, as we before stated, no measurements are of any value unless their exact signification is understood; in fact, if anything, they tend to mislead rather than to guide.

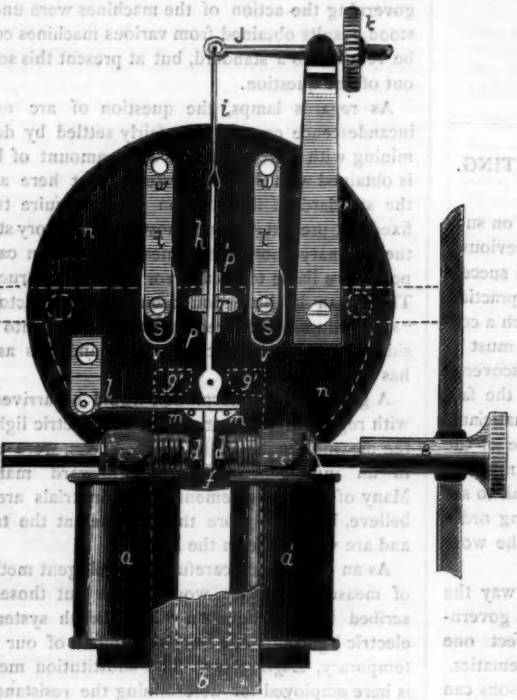


FIG. 1.

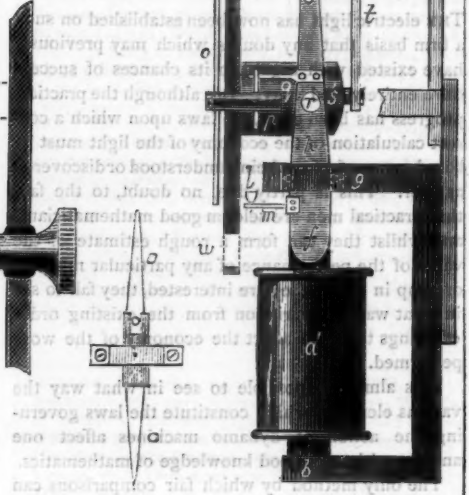


FIG. 3.

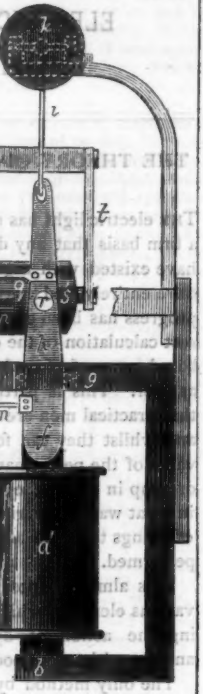


FIG. 2.

FIG. 4.

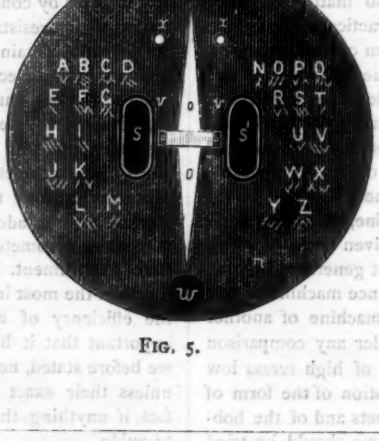


FIG. 5.

FIG. 6.

BRIGHT'S SINGLE NEEDLE SOUNDER.

THIS instrument, the invention of Sir Charles T. Bright, is practically an improvement on the ordinary single needle apparatus, and can be adapted to the latter, so that it can be used for reading from either by the eye or the ear. Fig. 1 shows the back of the dial of the improved instrument. Fig. 2 is a side elevation of the same, partly in section. *a*, a^1, are two electro-magnetic coils fixed to *b*, the lower pole of a permanent magnet (the middle of which is indicated by dotted lines), by which they are polarised; *c*, c^1, are the upper poles of the coils, and the soft iron pole pieces, *d*, d^1, pass through the poles, into which they are screwed, and their distance from each other can be regulated by means of adjusting keys applied to the brass square ends, *e*, e^1. The adjustment by this means is very delicate, and the polarisation is very perfect, owing to the intimate contact of the screw threads throughout the surfaces. An opening in the outer case of the instrument opposite to the square ends enables any adjustment to be made by the keys without removing the case, as shown by the key at e^1 passing through a hole in the side of the case, which is represented in section. *f* is the free end of a movable soft iron armature or tongue, which is polarised by *g*, g^1, the upper pole of the magnet, *b*, *g*, and has therefore an opposite polarity to that of the poles, *d*, d^1, between which it lies. The other end of the tongue is supported upon pivots in a slot cut in the pole of the magnet between *g*, g^1. A lever, *h*, h^1, made of aluminium for the sake of lightness, is extended from the axis of the tongue on the upper side of and in the same plane with it. The length of the lever is greater than that of the tongue, so that the application of force at its end has through its greater distance from the axis or fulcrum a leverage or mechanical advantage over the end of the tongue at the point where it is opposite the poles, *d*, d^1. The end of the lever is connected by a link of aluminium to the end of a small movable lever or arm, *j*, which is mounted on centres, as shown, and carries an adjustable weight, *k*. By the action of the weight through *i* upon the lever, the latter is retained in its place of rest or zero when no current is passing through *a*, a^1. *l* is a light pivotted arm resting upon two pins, *m*, m^1, standing out from a small plate fixed upon the tongue near to its axis, by which any vibration of the tongue and lever at the end of a beat or signal is checked. At a point in a line with the lever, about a third part of the distance between its axis and end, a light axle is pivotted in the same plane as the axis of the tongue, one end of which passes through the dial plate, *n*, *n*, and carries a light external indicating pointer or needle, *o*, *o*, and the other end inside the dial carries a short arm, *p*, *p*, which is slotted or forked at its upper end, and is engaged by a pin, *q*, projecting from the lever. At another point in the lever, about as far from its fulcrum as the length of the tongue, the hammer, *r*, is fixed. Two sounders, *s*, s^1, to be further described hereafter, are fixed by means of the steel plates, *t*, *t*, and studs, *u*, *u*, to the back of the dial plate, and the sounders serve as stops to limit the motion of the hammer and lever and of the needle outside the dial. Figs. 3 and 4 show the back and side views of the detached needle or indicator, *o*, *o*, with its slotted or forked arm, *p*, and the pin, *q*, which projects from the lever, *h*, *h* (figs. 1 and 2), and moves the needle to the right or left as the current through *a*, a^1, is positive or negative. *v*, *v* (fig. 1), are perforations in the dial, through which the sound is emitted, or through which the mouths of the sounders protrude. Fig. 5 shows the front of the dial, *n*, *n* (figs. 1 and 2), *o*, *o*, being the needle; *s*, *s*, are the mouths or outer ends of two flat-shaped tubes or sounders, corresponding to the parts indicated by the same letters in figs. 1 and 2, which enter into or are immediately opposite, and close to but not touching the sides of *v*, *v*, the two perforations, which are similar in shape to but a little larger than the mouths of the sounders. *w* is an opening in the dial to facilitate the adjustment of *d*, d^1 (fig. 1); *x*, *x*, are two small circular plates of ivory let into the dial, corresponding to the stops or pins of the ordinary needle instrument, but which are really false stops or indicating points, as the needle is not stopped against them, their surfaces being flush or nearly so with the dial. Upon the dial the letters of the alphabet and signs representing the beats to each side by which the letters are expressed are painted, as shown in the figure. The front of the dial is painted black, the needle white, and the lettering pale green, an arrangement which renders the visual signals very distinct to the operator. Fig. 6 shows a side view of one of the sounders, *y* being the outer or exposed end or mouth which is open, and *z*, the end inside the dial or screen which is closed, and is fixed to *t*, the metal plate, by which it is fastened to the stud, *u*, in figs. 1 and 2. *n*, n^1, show a section of part of the dial plate. The sounders are made of German silver. The instrument is stated to be more powerful than any of the instruments now in use in which signals are made to both sides of zero, either visually or direct to the ear, except by the aid of a relay and local battery. The current necessary to work it is comparatively small, and it is estimated that three-fourths of the battery power employed for working needle instruments might be saved if it were generally used. It is stated that with an ordinary Leclanché battery of 10 cells readable signals may be obtained, if the instrument is in proper condition, through 20,000 ohms resistance, and good audible signals through 12,000 ohms.

SYKES' RAILWAY SIGNAL APPARATUS.

THE object of this invention is to control the movements of signal levers by electrical action at distant stations.

The operation or working of the system at three given stations or signalling points, A, B, and C, is such that a lock at A is released by the forward motion of the starting lever at B, and the signal "clear" on an indicator at A is given by motion from a plunger at B. When the plunger has been acted upon to give the signal "clear" at A, as just mentioned, it cannot be acted upon again until the starting lever at B, which has been locked in its normal position, has been released by C. The

starting lever at B when in its other position, that is, when pulled over and the signal is down, is locked, and is released either by a treadle in advance of the signal or by a plunger under the control of the station staff at B; also, when the starting lever at B is pulled over and the signal is down, the plunger which releases A is locked until the train has passed over the treadle in advance of the starting signal or until the platform plunger has been used. Thus the signalman at B cannot give "clear" to A until B has given the train on to C, and C has released B's starting lever, which B must pull over and again put back after it has been released by the treadle or platform plunger, as above described. The back motion of B's starting lever brings two springs into contact, which then send a reverse current to a galvanometer at A, thus indicating to the signalman at A that the section of the line between A and B is "clear" (but not unlocking the lever at A), and that he can ask the signalman at B to accept another train, which the latter can do by a bell worked electrically or a telephone. No other block instruments are required, because not only is the galvanometer a block instrument in itself, but also the indicator is both a block and locking instrument.

FIG.1.

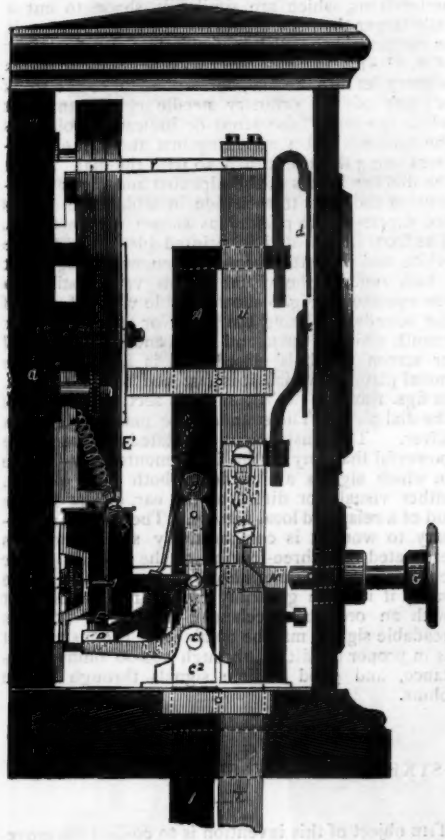
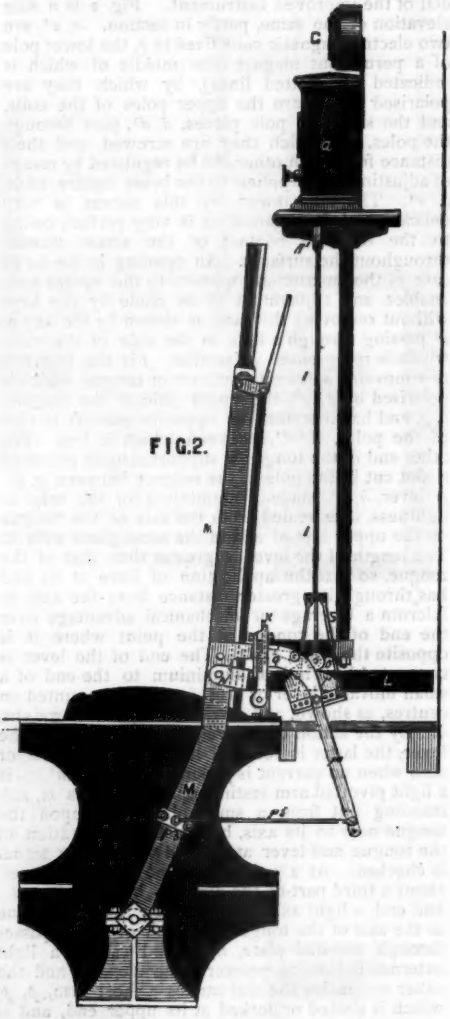


FIG.2.



Each signalman has in front of him, and over the lever, a case which contains the lock. The case has two oblong openings, behind which and within the case are indicating pieces, *d* and *e*, of tin; the piece, *d*, behind the upper opening is painted on the upper

half "clear" and on the lower half "blocked;" the tin, *e*, behind the lower opening, is painted on the upper half "train on," and on the lower half "train passed" or "clear." The pieces of tin are attached to blades marked respectively A and U, which pass through the bottom of the case, and are jointed to rods which are attached to the lower gear. The blade, A, to which is attached the upper tin, *d*, with the words "blocked" and "clear," is held up by an angle-piece, C (mounted on a stud, C^1, and bracket, C^2), which angle-piece rests under a pin, B. Part of the angle-piece is an armature, D, held up by the poles of an electro-magnet, E, which is attached to permanent magnets, E^1. The electro-magnet communicates by a wire through a galvanometer, G, with a spring in a case at the station in advance, which spring is put in communication with a battery by means of a plunger and angle-piece at this station, similar to those represented respectively at G and H, in fig. 1. The blade, A, is jointed at A^1 (fig. 2) to a rod, I, which is attached to a crossbar, J, lifting a sliding piece, K (which forms a lock), out of and into a notch, *f*, cut in a tappet, L. This tappet is attached to the signal lever, M, by means of a stud, N. Attached to the crossbar, J, is a roller, O, which is lifted by a cam, P, carried by a bracket, Q. This bracket is bolted to the bar, R. Mounted on the cam, P, is a T-shaped arm, P^1, connected by a rod, P^2 (fig. 2), to a pin plate, P^3, bolted to the signal lever, M. To a stud, R^1, in the cam, P, is attached a rod, S, which works a blade, T, forming a continuation of, but being a distinct piece from, the blade, U. This blade, U, which carries the lower tin piece, *e*, with the words "train on" and "clear," is held up by a click, V, which rests on a pin in the blade, T. The click, V, is pushed off the pin in this blade, T, by means of the plunger, G, and angle-piece, H, and this causes the blade, U, carrying the lower tin piece to drop. This blade, U, is put up by the signal lever, M (fig. 2), being pulled over, and as this lowers the blade, T, by means of the rod, S (fig. 2), which works it, the pin on T (fig. 1) is allowed to get underneath the click, V, so that the backward motion of the signal lever then raises both the blades, T and U.

When the signal lever is put back two springs mounted on a bracket, V, are pressed together by the blade, U, and a contact being thus made electric communication is carried to the galvanometer at the station "A" in the rear, which pulls the arm at that station to the "clear" position, and being a current from a different battery reverse to that sent by the plunger spring, before referred to, it does not repel, but attracts, the armature of the electro-magnet, E, in the case at the rear station, "A," and therefore does not unlock the signal lever.

By means of the treadle before referred to the passing of the last carriage of a train sends a current to the electro-magnets, E (fig. 1), and causes them to repel the armature, D (fig. 1), thereby dropping the blade, A, which carries the upper tin piece, and taking out the back lock so that the starting lever can be put back, and the "clear" signal be given to the station in the rear, the lever being itself simultaneously locked. As has been pointed out, this may be done by a hand plunger.

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.

XXVII. THE WHEATSTONE AUTOMATIC SYSTEM.—(*Continued.*)

CONSIDERABLE inconvenience was found to arise from the breaking of the driving chain in the transmitter instrument, and as the links were made of steel great difficulty was experienced in repairing the damage, which practically rendered the instrument useless. To overcome this defect links of *soft* steel used to be provided, which could be easily opened and closed again with a pair of plyers, and which could consequently be substituted for the broken link without trouble. Such soft links were, however, necessarily wanting in strength, and recently a stronger chain has been used with links of a peculiar make, which enabled any break to be repaired with the utmost facility and efficiency.

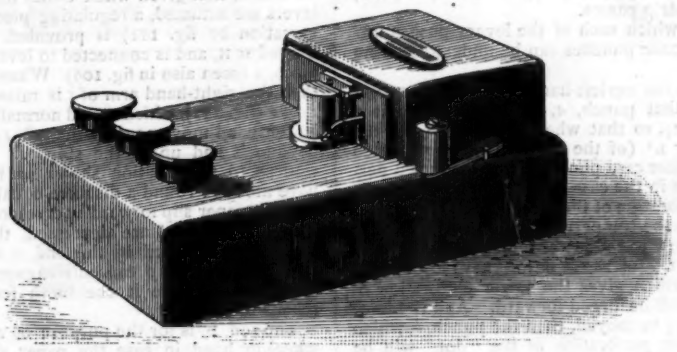


FIG. 108.

The openings of the new links are V-shaped, as shown by fig. 107; this device allows of any two links being "snapped" together with the greatest ease when held as shown in the right hand of the figure.

Care must be taken in joining a chain to see that there is no twist in it, as when the links are once

FIG. 107.

"snapped" together they cannot be separated. Should a twist accidentally occur it is necessary to break a link for the purpose of righting it.

THE PUNCHER.

The general form of the "Puncher" for punching the perforations in the transmitter slip is shown by fig. 108. It consists of a cast-iron box, the underside of which is shown by fig. 109, provided with three keys in the front; these keys are connected to punches, which on being actuated by the depression of one or other of the former, perforate holes in a strip of oiled paper.

The three keys are connected severally to three levers, L¹, L², and L³ (fig. 109), which are hinged in the block, B, at V_3. The shape of these levers is shown in L³ (fig. 110); on the end, *l*, being struck down by one of the keys the steel-faced end, l_1, is urged forward and pushes one or more of the punches, *a*, *b*, *c*, *d*, or *e*.

The lever, L², pushes forward the punches, *a*, *c*, and *e*.

The lever, L¹, pushes forward the punches, *a*, *b*, and *d*.

And the lever, L⁵, pushes forward the punch, *d*.

The ends of these punches pass through a steel plate, D, and between the latter, and a second plate, D_1, the paper strip passes.

The way in which each of the levers pushes forward the particular punches can be understood from fig. 110.

Referring to the top left-hand figure in fig. 110, it will be seen that punch, *a*, has attached to it a branch-piece, a_1, so that whether lever, L¹ (of the "dot" key) or L³ (of the "dash" key) be pressed forward, in either case punch, *a*, will produce a perforation, which in the case of lever, L³, corresponds to the top perforation of the "dash," and in the case of lever, L¹, to the top perforation of the "dot."

Referring now to the lower figure it will be seen that if lever, L³ (of the "dash" key) be struck, the punch, *c*, which gives the lower perforation of the "dash," will be urged forward. And if L¹ (of the "dot" key) be moved, then the punch, *b*, which gives the lower perforation of the "dot," will be urged forward.

Lastly, we can see from the middle figure that if the "dot" lever, L¹, be pressed, then the punch, *d*, giving the "rack" perforation, will be urged forward; and if lever, L³, be moved, then the punch, *e*, will give the rack perforation; and, again, if lever, L² (the "spacing" lever) be depressed, then the "rack" perforation from the punch, *d*, only will be given.

Thus each lever moves the punches required to give the perforations corresponding to it.

After each lever has been depressed and the punches corresponding to it have done their work, the paper requires to be drawn forward to the position at which the next perforations are to be made; this is done by means of the star wheel, *s* (fig. 111). The teeth of this star wheel fit into the "rack" perforations in the paper slip and draw it forward by a "rack and pinion" movement.

A pawl, *p*, drops into the teeth of the star wheel, being pressed against the latter by a wheel, *w*, which is itself pressed against *p* by a spring, *x* (fig. 112). The pawl, *p*, is hinged at the end of a lever, *r*, which is itself hinged at *f* to a lever, r_1; this latter lever is hinged at *g*, and is pressed forward by the action of the levers, L², L¹, L³. A strong spring, S, is connected to *r* by a link, *h*, and by its tension draws *r* against a stop, *i*, which thus acts as a fulcrum. It is evident, then, that if r_1 be pressed by the levers, L¹, L², or L³, that it will turn about the centre, *g*, and that the hinge-pin at *f* will cause *r* to turn round the centre, *i*, and thus move the long arm of *r* to the left, and pull the pawl, *p*, to the left. When the levers, L¹, L⁵, and L², return to their normal positions after being moved, then the levers, r_1, r_2, will be drawn back to the position shown in fig. 111, and the pawl, *p*, engaging in the teeth of the star wheel, *s*, will turn it round the distance necessary to move the paper forward the proper amount.

The exact distance the pawl, *p*, can turn *s* is regulated by the bent lever, L, which is adjusted by two screws, s_1, s_2.

The regulation of this lever should be such that if 121 "rack" perforations are made in a piece of paper slip, then the distance between the centre of the first and last holes should be as nearly as possible 12 inches.

As it is necessary that the movement forward of the paper slip after the lever, L³, is worked should be double that given when either of the other two levers are actuated, a regulating piece, *t* (shown in elevation by fig. 111) is provided. This piece is hinged at H, and is connected to lever, L³, by a tail-piece, *z* (seen also in fig. 109). When L³ is actuated, then the right-hand arm of *t* is raised, and the end, *e*, of *r* (fig. 111), which would normally be limited in its left-hand movement by the tail, t_1, can now pass beyond it and up to the stop, *y*. Thus, when *r* returns to the position shown in fig. 111, it will have moved *s* round a distance equal to two teeth, and the paper slip forward a corresponding distance.

When L¹ or L² are depressed, then the movement of *r* is limited by the end, *e*, coming against t_1; thus the pawl, *p*, can only engage with *s* in such a way as to move it one tooth forward when it recoils to the right.

The rod, D, is for the purpose of moving the star wheel by hand in case the paper slip sticks, as it sometimes does.

E is for the purpose of pushing back the punches in case they stick, as is sometimes also the case.

The little tongue, F, which is pressed upwards by the spring, s_3, keeps the paper slip in position as it passes before the punches.

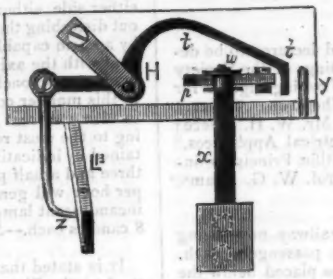


FIG. 112.

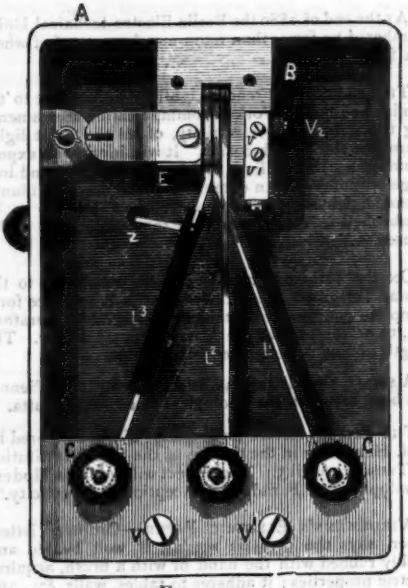


FIG. 109.

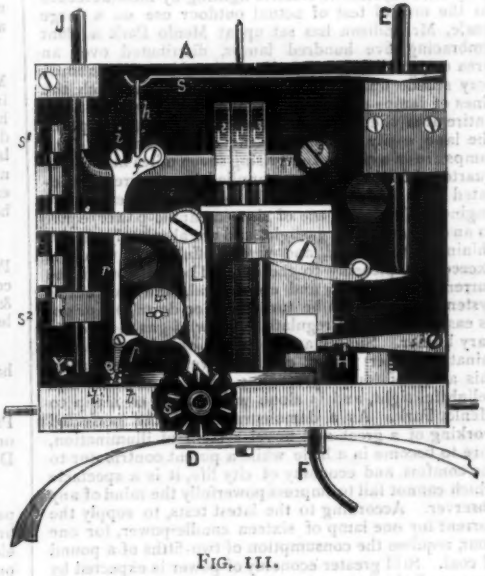


FIG. 111.

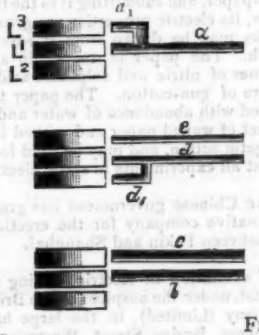
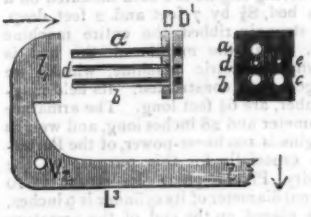


FIG. 110.



Notes.

AMONGST the papers to be read and lectures to be delivered at the ordinary general meetings of the Society of Arts, will be the following:—"Flashing Signals for Lighthouses," by Sir William Thomson; "Recent Advances in Electric Lighting," by Mr. W. H. Preece; "The Future Development of Electrical Appliances," by Prof. John Perry; "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S.

THE carriages of the electric railway now being erected in Berlin will carry twenty passengers each. The driving dynamo machine will be placed below the floor of each carriage. A speed of twenty miles an hour is expected to be attained.

ELECTRIC ILLUMINATION AT MENLO PARK.—To subject his system of electric lighting by incandescence to the crucial test of actual outdoor use on a large scale, Mr. Edison has set up at Menlo Park a plant embracing five hundred lamps, distributed over an area one mile long and half a mile wide. His laboratory stands upon a gentle eminence from which the lines of lamps extend half a mile to right and left, the entire area under illumination being, from the slope of the land, easily visible from the central station. The lamps are in a circuit comprising seven miles and three-quarters of wire, and are supplied by a current generated by nine dynamo-electric machines driven by one engine. The lamps are of sixteen candle-power, equal to an ordinary street gaslight, and are absolutely steady, shining with a mild and serene effulgence, which is exceedingly pleasing to the eye. The division of the current is complete and economical, and the entire system of lights can be turned up or down, off or on, as easily as one can regulate the flow of gas in an ordinary burner. Simply as an exhibition of perfect illumination under perfect control, covering a vast area, this array of lamps presents a most remarkable and delightful sight, and is alone well worthy of a trip to Menlo Park. As a demonstration of the perfected working of a great and novel system of illumination, sure to become in a little while a potent contributor to the comfort and economy of city life, it is a spectacle which cannot fail to impress powerfully the mind of any observer. According to the latest tests, to supply the current for one lamp of sixteen candle-power, for one hour, requires the consumption of two-fifths of a pound of coal. Still greater economy of power is expected by the use of the large generator now approaching completion. This is designed to replace sixteen of the largest machines of this kind previously made. The dynamo and the driving engine are both mounted on a massive cast-iron bed, 8½ by 7 feet and 2 feet deep, very heavy and strongly ribbed, the entire machine weighing 8 tons. Near the middle of the bed is mounted the dynamo-electric machine, which, we believe, is the largest ever constructed. Its field magnets, three in number, are 6½ feet long. The armature is 21 inches in diameter and 28 inches long, and weighs 1½ tons. The engine is 100 horse-power, of the Porter-Allen type, built especially for this purpose at the Southwark Foundry, Philadelphia. Its stroke is 10 inches. The internal diameter of its cylinder is 9 inches. The crank disc is placed on the end of the armature shaft. Steam pressure, 120 lb. per square inch. The engine cuts off at one-fifth of the stroke and makes 600 revolutions per minute. The working pressure of the dynamo is 140 volts; the resistance of the armature is one two-hundredth of an ohm. The current is taken from the commutator cylinder by twelve brushes, six on either side, either one of which may be removed without disturbing the others. These brushes are supported by an arm capable of being rotated on an axis coincident with the axis of the armature, so that they may be made to approach or recede from the neutral point, and in this manner control the current. This machine will furnish a current to 800 incandescent lamps. According to the most recent estimates as to economy, as obtained by indicating his present engine with 500 lamps, three and a half pounds of coal burned under the boiler per hour will generate a nett current sufficient for 8½ incandescent lamps of 16 candles each, or 16 lights of 8 candles each.—*Scientific American.*

IT is stated that an 800 horse-power engine will be used at the Electrical Exhibition at Paris to work 600 electric lamps, which are to be distributed about the building and grounds.

AT the end of 1880 the Berlin Electro-technical Union numbered no fewer than 1,575 members, 1,246 of whom are foreigners.

THE director of French Lighthouses has sent to the Minister of Public Works a communication recommending the lighting, by electricity, of all the great lighthouses on the French coasts. It will involve an expenditure of several millions of francs, which will end in a large economy and an extension of the range of illumination. A system of steam-trumpets is also to be established in connection with these improved lighthouses.—*Nature.*

ON the 11th inst. an application was made to the Postal Telegraph Department by the War Office for a complete equipment of telegraph *matériel*, operators, &c., to be shipped for the Ashantee coast to-day. The length of line to be erected is ten miles.

A SMALL electric railway, brought over from Vienna, has been set up in the Zoological Gardens, Calcutta.

THE Faraday lecture (in English) will be delivered by Prof. Helmholtz in the theatre of the Royal Institution on Tuesday, April 5. The subject will be "The Modern Development of Faraday's Conception of Electricity."

WIEDEMANN'S ELECTRIC PAPER.—Ordinary letter-paper, says the *Comptes rendus*, if well heated and briskly rubbed with the hand or with a brush, acquires electric properties; it adheres to tables, walls, &c., and on contact with the hand it gives slight electric discharges, visible in the dark. But on taking Swedish filter-paper, and submitting it to the treatment described below, its electric properties are greatly intensified, and sparks may be drawn from it several centimetres in length. The paper is steeped in a mixture of equal volumes of nitric and sulphuric acid, as in the manufacture of gun-cotton. The paper thus pyroxilised is washed with abundance of water and dried. If laid on a sheet of waxed paper and rubbed briskly it manifests energetic action, and may be used for the repetition of almost all experiments in static electricity.

THE Chinese government has granted a concession to a native company for the erection of a telegraph line between Pekin and Shanghai.

AN exhibition of electric lighting took place on the 3rd inst. under the auspices of the British Electric Light Company (Limited), in the large hall of the Palace Chambers, Bridge Street, Westminster, the object of the gathering being an inspection, with the aid of

practical illustrations, of Mr. Lane Fox's system of lighting and apparatus applicable for domestic use. The visitors, who were received by the directors of the above company, including the chairman (Mr. Joseph Hubback), were numerous, and included Mr. Shaw Lefevre, M.P., Lord and Lady Penrhyn, Lord Rae, Sir Charles Bright, Lady Frere, Lady Allen, Sir James M'Garel Hogg, M.P., and Lady Hogg, Sir Henry and Lady Green, Mr. Barty Mitford, Mr. Street, R.A., Sir G. Dasent, Lady Stanley of Alderley, Mr. Fitzroy Campbell, Admiral Sir E. Sotheby, Admiral Sir E. Inglefield, Sir A. Borthwick, Mr. P. W. Clayden, Colonel Peters, Dr. Leigh Adams, Major Harding, General Hyde, Colonel Woodhull, Mr. and Mrs. Spottiswoode, Mr. Ponsonby Fane, Professor Frankland, Professor Adams, &c. The hall was lighted by fifteen small incandescent lights, worked by a Gramme machine. The regulation of the motive force is automatic, and the currents are controlled by the generator. Mr. Fox estimates that if electricity were used on the same scale or to the same extent as gas the cost of producing an equal amount of light would be only about one-tenth. Mr. Fox maintains that electricity is, under his system, applicable for economical heating and cooking no less than for illumination. The "Lane Fox" lamp is almost identical with that of Edison, Swan, and Maxim, with certain important additions on the method of distribution and regulation. The British Electric Light Company have the sole rights in Mr. Fox's patents.

The following table is given by *Engineering*, in an article on the "Brush system of electric lighting," which shows well the capabilities of the system:—

Resistance:	
Resistance of the machine between terminals	10·55 ohms.
Resistance of external circuit ...	72·96 "
" whole " ...	83·51 "
" the sixteen arcs ...	70·86 "
Current:	
Electro-motive force of current ...	839·02 volts.
Volume of current	10·04 webers.
Power:	
Total driving power required ...	15·48 H.P.
Driving power absorbed in production of current	13·78 "
Energy of current expressed in horse-power	11·285 "
Percentages:	
Percentage of current available for external work	87·36
Percentage of current appearing as heat and light in the sixteen arcs	84·00
Percentage of gross power converted into current	72·90
Percentage of absorbed power converted into current	81·89
Percentage of gross power appearing in arcs	61·24
Percentage of absorbed power appearing in arcs	68·79

THE experiments for lighting a portion of the Marine Parade, Brighton, by electricity will shortly be made, temporary lamp pillars having already been erected on a portion of the Parade just eastward of the Chain Pier, and at a point where the light will fall both on the Esplanade and on the roadway at the foot of the cliff, known as the Undercliff Road. Four lights will be used for the experiments, which have been intrusted to Messrs. Siemens.

M. O. F. GRANDT, in a communication to the Académie des Sciences, proposes to propel ships by a novel method. The engines are to work dynamo machines, the current from which is to be used to decompose water, the mixed gases from which are then exploded in a tube at the stern of the ship, which thus drives the latter forward. A Grand(t) notion!

MR. CROMPTON informs us that at Wintherthur, Professor Hagenbach has been carefully carrying out some trials with the Bürgin machine recently made by Mr. Crompton in England. The Professor tested the Bürgin machine with an alternating current machine of Messrs. Siemens' and Halske's construction. The Siemens' machine with excitor, and with six differential lamps in circuit, took 8 horse-power, dynamometrically measured. The candle-power was at the same time noted by the chief engineer of the gas works at Wintherthur. The electric lights were compared with an argand burner of 25 candles, and this was again compared from time to time with the normal standard candle. The photometric and dynamometric measurements were simultaneous. The results were as follows:—

Siemens' machine, 6 lights, each of 350 candles, measured on horizontal line 8 horse-power, the total of candles per horse-power being 262.

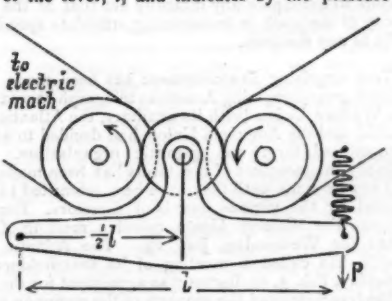
Bürgin machine, 3 lights, each of 1,360 candles, measured on horizontal line 5 horse-power, the total of candles per horse-power being 800.

Bürgin machine, 4 lights, each of 700 candles, 4·9 horse-power; total candles per horse-power 560.

Mr. Crompton says these compare with the best results obtained at Glasgow with the Gramme machine; in that case the candle power obtained was 590 per horse-power, measurements being taken horizontally in this as in the former cases.

As *relative* results we do not think the foregoing experiments of much value. If the same number of lights had been employed in each case something might have been arrived at, but total candle-power divided by horse-power when the number of lamps vary is not a fair comparison.

The horse-powers in these experiments were measured by means of an ingenious dynamometer, of which we give an illustration. The instrument was placed between the driving power and the dynamo machine; it consists of three axles with gearing wheels of one metre circumference. A spring balance is fixed to the end of the lever, *l*, and indicates by the pressure of



the teeth of one wheel on the other the amount of force exerted. This pressure multiplied by the number of revolutions per minute gives the power expended in kilogrammetres.

THE *Oesterreichische-Ungarische Post*, in an article on the future position of telegraph officials, concludes with the words:—"The telegraphist will remain the pariah of the civil service. Much work under un-

healthy conditions, no prospect of promotion, early invalidism, and untimely death."

THE number of telegrams despatched in Vienna during the month of December, 1880, was 90,379.

WE understand that in Edinburgh, the central stations of the Scottish Telephonic Exchange and United Telephonic Company are about to be put in connection, in consequence of arrangements, which are all but complete, for the amalgamation of these companies. The Post Office authorities, we are informed, have expressed their willingness to concede largely on the terms they originally proposed to these companies.

EXPERIMENTAL RESEARCHES ON MAGNETIC COERCITIVE FORCE.—D. Kulp.—The author magnetises iron and steel rods in spirals, which he opens before taking out the rods. On percussion, the permanent magnetism of the rods is partly increased, partly diminished, and partly inverted. As a series of induced currents arise in the rods on opening the spiral they have been exposed to magnetising forces in alternating directions, whereby their behaviour is explained.—*Wiedemann's Beiblätter.*

RECEPTION OF PROFESSOR BELL.—A grand reception has been recently given by the Mayor and Corporation of Brantford, to Professor Bell. The reception was attended by about 300 people. After the presentations the Mayor presented an address to Professor Bell, to which the latter made a suitable reply. An address was then presented by the Board of Trade, to which a reply to the following effect was made:—It might not be uninteresting to them, although not connected specially with trade, if he were to make some remarks upon his recent discovery of the photophone. He described it as at present rather a contribution to science than to the world's utilities, but he looked forward to important practical applications. Among them he specified communication between passing ships at sea, lighthouses and the shore, and in case of war communication with distant places could be received without the necessity of any intervening wire. He then described the apparatus and experiments, and added that he had spoken for a distance of 800 or 900 yards, and had sent the musical sound a mile and a quarter, but he saw no reason to anticipate any difficulty but that of the convexity of the earth in transmitting articulate speech by light to any distance.

THE surprising announcement has been made that the two great competing American telegraph companies, the Western Union (with its auxiliary, the Atlantic and Pacific) and the American Union, had decided to amalgamate and form one gigantic organisation. No official announcement of the terms has been made, nor will any be made until they have been submitted to and ratified by the various boards of directors. For this purpose the Western Union called a meeting of the board for Wednesday, Jan. 19. The Atlantic and Pacific has called a meeting of its shareholders for Saturday, Feb. 5, to discuss "an agreement for the sale of the franchises and the property of the company to the Western Union Company." As all the officials refuse to make public the details of this agreement, no positively accurate statement can be given, but the following is believed to be correct: The consolidated company is to retain the title of the Western Union Telegraph Company, with a capital of 80,000,000 dols. To perfect the company a new certificate of incorporation, with the capital fixed at that amount, is to be filed. The shares of the several companies are to be merged in the consolidated company at a valuation of about 129 for Western Union, 113¾ for American Union, and 66¾ for Atlantic and Pacific. This means practically, scrip dividends of 29 per cent. on Western Union, and 13 per cent. on American Union, making the capital of the first, in round figures, 53,000,000 dols. The capital of the American Union is 10,000,000 dols, but it is also pledged to issue 5,000,000 dols. of bonds to the subscribers of the Central Construction Company, which furnished the funds to construct its line. These bonds, it is said, will be issued at once, and for the purposes of consolidation the entire capitalisation of the company, including both stock and bonds, will be taken as the basis. The valuation of its 15,000,000 dols. capital at about 113¾ equals, in round numbers, 17,000,000 dols. The capital of the Atlantic and Pacific Company is 14,000,000 dols. stock. It has no bonded debt. At the valuation of 66¾ per cent., or thereabouts, its capital is not far from 10,000,000 dols. in the consolidated company. The three companies will then come into the consolidated company approximately as follows: Western Union, 53,000,000 dols.; American Union, 17,000,000 dols. and Atlantic and Pacific, 10,000,000 dols.; total, 80,000,000 dols. It is understood that Mr. Gould, Mr. Sidney Dillon, General Eckert and Mr. Russell Sage are to be elected directors in the new company, and that vacancies will be made for them by the resignation of a corresponding number of the present directors of Western Union.—*Operator.*

RE THE EDISON TELEPHONE COMPANY OF LONDON (LIMITED).—This was a petition by a shareholder tried on the 22nd ult. before the Master of the Rolls in the High Court of Justice for the winding-up of this company, which was formed in August, 1879, with a nominal capital of £200,000 in 2,000 shares of £100 each. Under the articles of association, Mr. Edison was entitled to certain royalties during the continuance of certain patents belonging to him, and he also had the right to a voting power upon resolutions to be passed equivalent to one-half of the aggregate votes of the shareholders voting at any meeting. In May, 1880, this company and the Telephone Company agreed to amalgamate, and a new company entitled the United Telephone Company was formed, with a nominal capital of £500,000 in 100,000 shares of £5 each, 23,000 of which shares were allotted as fully paid up to this company as a consideration for the business made over by such company. These shares were the only property now belonging to this company, and the Court was now asked for a winding-up order on the ground that the company had ceased to carry on its business. Mr. McNaghten, Q.C., and Mr. Latham appeared in support of the petitioner; Mr. Millar, Q.C., and Mr. Renshaw, on behalf of Mr. Edison, opposed the petition; Mr. Chitty, Q.C., and Mr. Cozens Hardy for the company, and Mr. Giffard, for certain shareholders supported the petition. The Master of the Rolls said that the company had been formed for the purpose of carrying on telephonic business, and amongst its powers was a power of selling its business. Mr. Edison had not exercised his voting power to prevent the business being sold, as he might have done, and the sale, therefore, so far as he was concerned, was a valid sale. There was no property to divide except the 23,000 shares in the United Company, and Mr. Edison might be entitled to a portion of these shares under the winding-up. In his lordship's opinion an order for winding-up the company ought to be made, and he therefore made an order accordingly.

ON THE NON-EXISTENCE OF RADIANT MATTER IN THE CROOKES' TUBES.—A. Voller.—The writer first objects to the expression "dark space" used by Mr.

Crookes for one of the layers of cathodic light, since this name has been commonly applied to the space situate between the positive and negative discharge. He shows further, by a series of experiments, that the deflection of the discharges by the magnet are determined by the laws established by Hittorf and Plücker; the rays proceeding from the negative electrode behave like a current fixed at one end and freely moved at the other. From the circumstance that conductors charged with static electricity are without influence upon the discharge, the author concludes that the view of Crookes cannot be upheld. The apparent repulsion of two cathode rays directed obliquely towards each other depends, according to the author, on the internal resistance of the cathode rays.—*Wiedemann's Beiblätter.*

ON THE TEMPERATURE OF THE ELECTRIC LIGHT.—Fr. Rosetti.—E. Becquerel showed in 1860 that the temperature of the luminous arc produced by a battery of 80 Bunsen elements is between 2070 and 2100° C, assuming that the luminosity and the heat radiation increase proportionally, according to the law of Dulong-Petit—a supposition not quite accurate at high temperatures. Rosetti throws the heat-rays from a given surface of the electrodes upon a thermic battery connected with an astatic mirror-galvanometer. From a number of experiments with 160 Bunsen elements with Duboscq's lamp, it appears that the temperature of the positive carbon lies between 2,400° and 3,900° C. It is so much the higher the smaller the radiating surface, supposing that the surface includes the extreme point; the temperature of the negative electrode varies between 2,138° and 2,530° C. Hence the temperatures of the extreme points of the electrodes are not below 2,500° and 3,900° C. In a Reynier lamp connected with 8 to 10 Bunsen elements the temperature of the positive carbon amounted to 2,406°—2,734° C.—*Ath. dell. Ist. Venet.*

A NEW GALVANIC BATTERY WITH A CIRCULATING LIQUID.—L. Ponci.—Rectangular troughs of lead, about 17 cm. long and 6 cm. broad, are bent at one end into the form of a beak, and arranged in a sloping position (with a fall of 15 mm.), so that the beak of the first lies over the broad end of the next lower one. In the troughs lies an amalgamated zinc plate, and upon it a coke plate, isolated from it by means of two caoutchouc rings, and perforated beneath the beak of the upper lead trough. The lead troughs are fitted with wires, and the coke plates at their upper ends with pressure screws, by which they are alternately connected. Through a system of such elements there is conducted, by means of caoutchouc syphons, a solution of yellow chromate of potash (200 parts in 2,000 water and 1,000 of commercial hydrochloric acid). A battery of 99 such elements yields an arc equal to that of 60 Bunsen elements, and its action is constant.

CONSTANT GALVANIC ELEMENTS.—J. Moser.—To prevent the solution of sulphate of copper in a Meidinger element from penetrating upwards to the cylinder of zinc fixed above, and to prevent copper from being deposited upon it, Moser suspends, by means of a thread below the zinc cylinder, a slip of zinc a few centimetres in length, upon which the blue vitriol deposits its copper.—*German Patent*, No. 1,723.

MR. SWAN'S ELECTRIC LIGHT.—During the past few days a company has been formed for the purpose of acquiring the right to use Mr. Swan's patent. The company consists of local gentlemen, and is named "Swan's Electric Light Company." The directors are:—J. C. Stevenson, Esq., M.P. (chairman), J. W. Swan, Esq., A. S. Stevenson, Esq., J.P., Hilton Philipson, Esq., James Craig, Esq., Dr. Marz, and J. C. Swan, Esq. Messrs. J. and R. S. Watson, Pilgrim-street, are the solicitors to the company. The capital is £100,000, and the applications for shares have been very numerous. The value of the shares is £10 each.

AURORA BOREALIS.—There is no doubt that the display of aurora borealis, witnessed in Scotland on 31st January, was of unusual grandeur. At Kirkwall it appeared in the zenith about 6 o'clock like a luminous cloud, from which darted rays of light, stretching on either side to the horizon in the east and west; other rays shot up from behind clouds in the northern horizon; and in the south, notwithstanding the presence of banks of clouds, rays were occasionally visible. At times the whole sky, from the zenith downwards to the east, west, and north was brilliantly illuminated; the aurora showing all the colours of the spectrum. The effects produced by the rapid motion and mingling of the many coloured rays were beautiful. Later in the evening the sky became overcast. At Thurso and Wick, between 6 and 8 p.m., the whole southern sky was brilliantly lighted by the aurora. At times the rays darted from the zenith in a northerly direction; at others dispersed towards all points of the compass; the colours the while quickly changing from pale yellow to deep crimson. At Banff the whole heavens were lighted as with flames of fire from all points. Rays of light shot from behind banks of clouds towards the zenith, frequently broadening out into belts, with a peculiar wavy motion. For fully half an hour the phenomena continued with undiminished splendour, and was such a sight as is but rarely witnessed in that part of the country. At Portsoy, from N.E. to N.W., the rays shot up into the zenith, converging to a point. While the rays in the north were of a pale gold colour, those in the west oftentimes assumed a deep crimson. At Aberdeen, Edinburgh, and other places the aurora was observed up to midnight. At Berwick-on-Tweed, when first noticed, between 6 and 7 p.m., the atmosphere was clear, cold, and frosty—the rays of light, after flickering for a few minutes on the northern horizon, shot up in remarkably vivid, but every changing streaks of light towards the zenith, illuminating the greater part of the heavens in the east and west.

TELEPHONY BY THERMIC CURRENTS.—Whilst in telephonic arrangements, based upon the principle of magnetic induction, a relatively considerable expenditure of force is required in order to set the tightly-stretched membrane in vibration, in the so-called carbon-telephones only a very feeble impulse is required to produce the differences in the current necessary for the transmission of sounds. In order to produce relatively strong currents, even in case of sound-action of a minimum strength, Franz Kröttlinger, of Vienna, has made an interesting experiment to use thermo-electric currents for the transmission of sound to a distance. The apparatus which he has constructed is exceedingly simple. A current of hot air flowing from below upwards is deflected more or less from its direction by the human voice. By its action an adjacent thermo-battery is excited, whose current passes through the spiral of an ordinary telephone, which serves as the receiving instrument. As a source of heat the inventor uses a common stearine candle, the flame of which is kept at one and the same level by means of a spring, similar to those used in carriage-lamps. On one side of the candle is a sheet-metal voice-funnel fixed upon a support, its mouth being covered with a movable sliding disc, fitted with a suitable number of small apertures. On the other side a similar support holds a funnel-shaped thermo-battery. The single bars of

metal forming this battery are very thin and of such a shape that they may cool as quickly as possible. Both the speaking-funnel and the battery can be made to approach, at will, to the stream of warm air rising up from the flame. The entire apparatus is inclosed in a tin case in such a manner that only the aperture of the voice-funnel and the polar clamps for securing the conducting wires appear on the outside. The inside of the case is suitably stayed to prevent vibration. On speaking into the mouth-piece of the funnel, the sound-waves occasion undulations in the column of hot air which are communicated to the thermo-battery, and in this manner corresponding differences are produced in the currents in the wires leading to the receiving instrument.—*Oesterreichische-Ungarische Post.*

Correspondence.

A CURIOUS TELEPHONIC CIRCUIT.

To the Editor of THE TELEGRAPHIC JOURNAL.

SIR,—While experimenting with the Gower-Bell telephone on a metallic circuit of 50 m. (each wire), by mistake, instead of the telephone wires 1 and 2 being properly joined, 3 and 4, two independent wires, were substituted at one end of the circuit, the telephone at the other end remaining connected to 1 and 2. Notwithstanding that the only possible path from one telephone to the other was the leakage through the atmosphere of each pair of vertically parallel wires, (the arms being earth wired), speech was distinctly audible both ways.

Yours truly,

E. T. ROLLS.

L. & S. W. Railway,
Exeter, Feb. 4th.

New Patents—1881.

412. "Signals upon railways." T. MASTERS. Dated January 31.

416. "An improved, combined low-water alarm and safety-valve for steam boilers." G. WILSON. Dated January 31.

455. "Signal buoys." F. BARR. Dated February 3. (*Complete.*)

473. "A new or improved system or mode of, and apparatus for, conveying or transporting money, documents, and parcels in mercantile and other like establishments." E. P. ALEXANDER. (Communicated by J. C. White and H. H. Hayden.) Dated February 4.

474. "Galvanic batteries." J. C. and G. FULLER. Dated February 4.

476. "Improved method of, and means or apparatus for, preventing collisions of railway trains." W. L. WISE. (Communicated by Ronfant and Gaye.) Dated February 4.

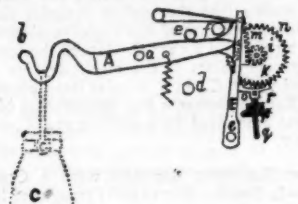
497. "Electro-magnetic induction machines." H. WILDE. Dated February 4.

518. "Signal apparatus for use in building vessels and other places or situations." H. BOTTEN. Dated February 7.

519. "An improved construction of alarm apparatus." P. EVERITT. Dated February 7.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1880.

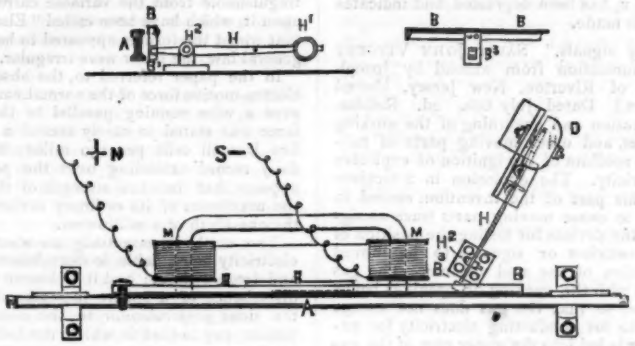
2468. "Apparatus for telephonic signalling." EDWARD HIBBERD JOHNSON. Dated June 18th. 6d. Relates to improvements in that description of apparatus employed in telephonic signalling in which a movable hook or support carrying the telephone receiver is used for the purpose of automatically controlling the connections and effecting the signals. The movement of the lever carrying the hook or support is retarded by the employment of an escapement, thus affording the requisite time for making one or more effective contacts between the signalling battery and the line, whether the hook or support be moving upwards or downwards. A is a vibrating lever mounted upon a centre or fulcrum, *a*, and terminating at its outer extremity in a hook or support, *b*, for carrying the telephone receiver, C, in the usual manner. *c* is a contact screw through which a relay which brings into operation a bell is placed in circuit with the line when the lever, A, is in the position indicated in the figure, with the telephone receiver, C, on the hook or support, *b*. *d* is another contact screw through which the telephone receiver, C, is placed in circuit with the line when the telephone is off its hook or support, *b*, and the bell cut out. E is another vibrating lever mounted upon a centre or fulcrum, *e*. This lever, when A is in contact with *d*, is in contact at its upper extremity with a contact screw, *f*, which places the transmitter in



circuit, the lever being connected at *e* to a conductor leading to the battery, but the lever is out of contact with the said contact screw, and the transmitter is consequently out of circuit, when the parts are in the position shown in the figure. The lever, E, is made with uninsulated portions, *s*, *s*, in order that the portion, *h*, of the lever in its upward and downward motion against the lever, E, may send intermittent contacts out to line. In order to render the movements of the lever, A, slow, so that the contacts may be of sufficient duration, a spur wheel, *i*, is fixed fast on a spindle, *k*, which is carried in bearings. With this pinion engages a segmental rack, *m*, formed on the end of the lever, A, so that as the lever moves upwards or downwards motion is imparted to the said pinion. On the spindle, *k*, of the pinion, *i*, is also secured an escape wheel, *n*, with the teeth of which engage the pallets of an anchor, *o*, pivotted at *p*; the anchor carries a pendulum, *q*, the bob, *r*, of which may be adjusted in position so as to vary the velocity of motion of the escapement as required.

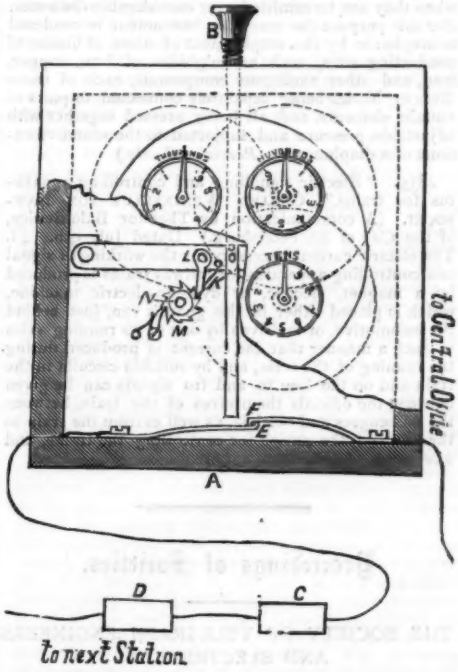
2526. "Railway signals." ERNEST ALFRED SULLIVAN. Dated June 22nd. 6d. The object of this invention is to produce an audible signal to be used on railways, more especially in foggy weather, or at such times as the ordinary semaphore signals cannot be readily seen. Alongside one rail of the track is

placed a length of iron, by preference, stout angle iron, of such a length that the second wheel on that side of an engine or other vehicle may rest upon it before the first one leaves it, so that once pushed down it may remain down while the train passes and produce only one sound. This length of iron or side rail is so arranged that one end at least of it shall be capable of rising and falling, the other end being pivotted. In the figures, A is the ordinary rail and B the side rail, placed outside the track. B^1 is a spring for holding up the side rail, B. D is a gong, H is a striking lever with a head, H^1, pivotted at H^2, and with its shorter end working in the bracket, B^2, attached to the side rail, B. A passing wheel necessarily depresses the side rail, B, and thereby forces down the short end of striking lever, H, and raises the head, H^1, and sounds the gong, D. The side rail being long the first wheel will not get clear until another is upon it, and the gong will only be sounded once for each train or single engine passing. An electro-magnet, M, is placed with its poles below and in close proximity to the side rail. When the current from the ordinary apparatus in the signal box is passed through the wires, N and S, the rail is drawn down, so that the wheels of the train cannot depress it and sound the gong; upon the current being discontinued it rises again.



2564. "Galvanic batteries." ROBERT CHAPMAN ANDERSON. Dated June 22rd. 2d. Relates to improvements in that class of galvanic batteries known as the "Daniell battery," the object of the improvements being to increase the power and useful effect of such batteries and to prevent the deposit of copper on the zinc element. The negative element is immersed in oxalate of copper dissolved in muriatic acid more or less diluted according to the strength required. In order to prevent the deposit of copper on the zinc or positive element two porous pots are used (instead of one only) placed one within the other, with an intervening space filled with a solution which will act as a good conductor of electricity, and in this solution are placed metallic iron or other metal which will precipitate copper from its solution, the zinc element being placed in the inner porous pot. (*Provisional only.*)

2643. "Registering apparatus for telephones." JOHN HENRY JOHNSON. (A communication from abroad by Charles James Bell and Sumner Tainter, of the United States of America.) Dated June 20th. 8d. Relates to apparatus for registering the number of times which the several telephones in a telephone system or exchange, comprising a number of stations or subscribers' offices connected with a central office, have been used. The figure illustrates the combination of the telephone call registers with the usual appointments of a telephone station. B, the push knob or key used for calling the central office; C, the call bell by which a subscriber is called, and D, the telephone and transmitter arranged in any convenient or suitable manner. In the telephone system here indicated a galvanic battery at the central office is placed in circuit with the line and instruments shown in the diagram. The depression of the push knob or key, B, breaks the circuit by separating the contact pieces, E, F, thereby causing a signal at the central office. The push knob, B, is attached at the point, G, to the actuating lever, H, whose fulcrum is at I. The pawl, K, is pivotted to a



lever at L, and turns the ratchet wheel, M, through one tenth part of a revolution each time the push knob, B, is depressed. The ratchet wheel, M, is geared to a train of wheels which move pointers round dials as in an ordinary gas meter, and thus register the number of times the knob, B, has been depressed, and indicates the number of calls made.

2754. "Railway signals." SAINT JOHN VINCENT DAY. (A communication from abroad by Joseph Stokes Williams, of Riverton, New Jersey, United States of America.) Dated July 6th. 2d. Relates, firstly, to the operation and governing of the working of signals, switches, and other moving parts of railways, through the medium of the ignition of explosive materials by electricity. The explosion in a receiver is, according to this part of the invention, caused to create a vacuum to cause moving parts (such as signals, switches, or the devices for testing the position of or holding the switches or signals) to be moved through the creation of the said vacuum. The gas receiver is formed with the opening or openings below the upper surface, so that the gas does not escape thereby. The wire for conducting electricity for exploding the charge is led into the upper part of the gas receiver. (*Provisional only.*)

2826. "Telephones." JOHN IMRAY. (A communication from abroad by Doctor Cornelius Herz, of Paris.) Dated July 9th. 2d. Relates to telephonic instruments and conductors, whereby articulate speech and musical sounds are electrically transmitted from one station to another, the object of the invention being to obtain great distinctness in the sounds, even when they are transmitted over considerable distances. For this purpose the receiving instrument is rendered microphonic by the employment of discs or blades of conducting ores, such as sulphides of iron, copper, lead, and other analogous compounds, each of those discs or blades being separately connected to pairs of voltaic elements, and all being pressed together with adjustable pressure and subjected to the sound vibrations of a diaphragm. (*Provisional only.*)

2835. "Electric signalling and controlling apparatus for trains." GERARD WENZESLAUS VON NAWROCKI. (A communication by Theodor Balukiewicz, of the City of St. Petersburg.) Dated July 9th. 4d. The electric current necessary for the working of signal and controlling apparatus for railway trains is produced by a magnet, electric, or dynamo-electric machine, which is placed either in the guard's van, just behind the locomotive, or is driven by one of its running axles in such a manner that the current is produced during the running of the train, and by suitable circuits in the train and on the line to and fro signals can be given between the officials themselves of the train, between the passengers and officials, as well as from the train to the line and the station for controlling the trains, and *vice versâ*. (*Provisional only.*)

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.

AN ordinary general meeting of this Society was held on Thursday, February 10th, Professor CAREY FOSTER, President, in the chair. The minutes of the last general meeting having been read and confirmed, and the list of new and proposed members read, Mr. ALEXANDER J. S. ADAMS read a paper on "Earth Currents."

In a previous paper on the subject, the author had asserted that the *normal* earth current was clearly distinguishable from the variable currents that break in upon it, which have been called "Electric Storms," and that whilst the former appeared to be obedient to some general law, the latter were irregular.

In the paper referred to, the absolute value of the electro-motive force of the normal earth current passing over a wire running parallel to the line of greatest force was stated to rarely exceed a strength equal to five Daniell cells per 150 miles; but, from a careful daily record extending over the past two years, it appears that the usual strength of the earth current at the maximum of its ordinary variation rarely exceeds the one-tenth of a milliweber.

The earth is essentially an electrified sphere, its electricity being liable to disturbance both from within and from without; and it is known that the electrical disturbance of a sphere increases its electricity upon the sides *perpendicular* to the disturbing force, in a similar way to that in which the tides act in reference to the moon.

It appeared that the probable cause of electrical disturbance on the earth was the sun, but investigation showed that this was not the case, as the variations of one day did not agree with those of another.

In 1878 the author commenced an analysis of the observation figures furnished by Mr. James Graves (member of the Society of Telegraphic Engineers) in 1873, from which it seemed probable that the cause was *lunar*, and the variations *lunar*-diurnal. In March and April, 1879, a further systematic course of observation was made on a wire, the ends of which were connected to the earth, one at Cardiff and the other through a sensitive astatic galvanometer at London, every quarter of an hour from March 28th to April 26th, with few exceptions, and the curves of the figures so obtained are as remarkable for their regularity as for the clearness with which they indicate the *lunar* origin of the variations they represent.

It is an important fact that the normal earth current variations of our globe are almost wholly controlled by the moon, for whilst the *magnetic* variations at different localities are more or less complicated, and are influenced apparently by more than one disturbing power, the earth's *electrical* disturbance is not so affected.

If it be taken for granted that, whilst the moon for the time being is stationary, the earth, by her rotation, presents Greenwich during the lunar day successively to all parts of the lunar orbit, then two maximum, two minimum, and four zero, points occur, Greenwich, in about three hours, reaching an electrical zero or point of least current; and three hours later still, a second maximum, but of different kind, is experienced. Another three hours, and a second zero is passed, and again three hours brings Greenwich opposite the moon's nadir, and also to a maximum similar in sign to the first.

Precisely similar features obtain for the other half of the lunar day, and the result of this analysis as regards the current phases of one lunar day is equally true of any other lunar day in the year.

According to the hypothetical arrangement of the earth's electricity, if the moon's age be given with an allowance for retardation, the electric curve which should be forthcoming at a given time for any given spot upon the earth's surface should admit of accurate prediction—a conclusion warranted by the results of one or two experimental trials that have been made.

The *retardation* is a peculiarity clearly indicated by

the variation curves, *as compared with lunar time*, and is a lagging of the electric curve some hours in rear of the moon: thus, Greenwich appears to strike the major pole three or four hours after the moon's precise time of southing for that meridian, and so also as regards all the other electric phases.

Another feature noticeable about the lunar-diurnal variation is an apparent enlargement and contraction of the *major pole curve* in sympathy with the height of the moon above the horizon.

There is also an indication that a similar expansion arises in connection with the age of the moon generally.

The *direction* and flow of the earth current have not been yet satisfactorily accounted for. It is a curious fact, however, that if the earth-current electro-motive forces be supposed to revolve about the *electric-perpendicular*, as an axis, in a *contrary* direction to the earth's rotation, and take the mean of the two, a line of directive influence for the earth current is obtained, agreeing with that derived by observation.

One of the most important results of these investigations is the agreement apparent between the earth-current and the *magnetic* lunar-diurnal variations.

In the case of each of the elements we find a double progression in each lunar day.

The declination has two easterly and two westerly maxima, and the inclination and total force have likewise two maxima and two minima in the same interval, the variation in each case passing zero four times during the lunar day.

From the evidence, the author argued that it is established that the motions of the true earth current constitute a series of tidal ebb and flow very similar to that of the waters of our globe; the chief difference being that, whereas in the case of the ocean there occur *two* flows and ebbs in each lunar day, with the earth's electricity there are *four*—a dissimilarity, however, that may yet prove to be more apparent than real.

In the discussion which followed the reading of Mr. Adams' paper,

Professor ADAMS stated that he hesitated to accept the theory that the distribution of static electricity at different portions of the globe, as would be caused by the moon's influence, could cause currents. Rowland proved that it required motion of the static electricity to cause a current. With regard to the retardation observed in the current beyond the period of the moon's phases, it had been observed that the magnetic changes took place instantaneously all over the globe, as observations had exactly proved. The cause of the currents is probably direct magnetic disturbances and is due to the action of the moon on the solid crust of the earth, this produces electrical tides like ordinary tides.

Mr. SAUNDERS stated that he had made numerous observations on earth currents since 1858, the results of which he had not fully worked out, but he would present the papers to the Society for investigation.

Mr. ELLIS said that magnetic observations do not show lunar curves unless the results of irregular disturbances are eliminated, as has been done by Sir Edward Sabine. The number of irregular observations it is necessary to exclude is about one-seventh of the whole. He thought that if Mr. Adams excluded some of the more irregular observations he might get a closer agreement with the lunar curves.

Mr. WOLLASTON stated that he had commenced observations on earth currents, in conjunction with Mr. Barlow, as early as 1846. When the Dover-Calais cable was first laid he made a series of observations, which he subsequently found agreed *exactly* with the ebb and flow of the tide. He stated that the results had been predicted by Faraday. The currents observed, he considered, were purely due to the mechanical action of the tide. A further series of experiments made on a cable across the Thames confirmed this view, as the current in the wire increased or changed its direction exactly as the tide in the river rose and fell. A retardation was noticed, which he accounted for on the supposition that the upper portion of the water did not flow synchronously with the lower layers. He thought that the currents observed by Mr. Adams on the London-Cardiff wire were generated by the tide in the river Severn, through which a cable ran which formed part of the route of the circuit.

Professor PERRY pointed out that the rotation of a sphere charged with static electricity would produce a current.

The discussion was then adjourned.

City Notes.

Old Broad Street, February 11, 1881.

ANGLO-AMERICAN TELEGRAPH COMPANY (LIMITED).—The ordinary half-yearly meeting of the shareholders of this Company was held on February 4th, at the City Terminus Hotel. Visct. Monck presided. The report stated that the total receipts from the 1st July to the 31st December, 1880, including a balance of £1,187 7s. brought over from the last account, amounted to £220,910 11s. 3d. The traffic receipts showed a decrease of £170,166, as compared with the corresponding period last year, caused by the competitive tariff in force during the greater part of the six months. The total expenses of the half-year, including repair of cable, income tax, &c., as shown by the revenue account, amounted to £58,344 4s. 5d. The directors, under the powers conferred upon them by the articles of association, had, before declaring the net profits, set apart the sum of £75,000 to the renewal fund, leaving an available balance of £87,566 6s. 10d. Interim dividends of 10s. per cent. on the ordinary stock, and £1 per cent. on the preferred stock, free of income tax, were declared on the 8th October, and paid on the 15th November last, absorbing £35,000, leaving a balance of £52,566 6s. 10d., out of which the directors recommended the proprietors to declare final dividends, free of income tax, of 15s. per cent. on the ordinary stock, £1 per cent. on the preferred stock, and 10s. per cent. on the deferred stock, amounting altogether to £52,500, making a total distribution for the year ended the 31st December, 1880, of 3½ per cent. upon the ordinary stock, 6 per cent. upon the preferred stock, and ½ per cent. on the deferred stock, leaving a balance of £66 6s. 10d. to be carried forward to the next account. After the declaration, but before the payment of the interim dividend, a holder of £50 of deferred stock, whose name appeared on the register for the first time on the 17th October, served the directors with a writ, to restrain them from paying dividends "without having assets to represent capital," and notice was given that if any dividend were paid after the service of the writ, the plaintiff would seek to make the directors personally liable for repayment of the amount to the Company. Hence the declaration of the dividend recommended is dependent upon the result of legal proceedings. The chairman, in moving the adoption of the report, stated that the dividend would be paid as soon as the directors had obtained a decision that they could do so without incurring personal liability, and he did not think that the

payment would be long deferred. An action against the Company had been taken by a gentleman who had a holding of the value of £16 only. It was an extraordinary state of the law that allowed a company to be hung up for several months by persons in such a position. But their Company was not singular in that respect; for the same thing could be done in connection with the Bank of England, and therefore he considered that the law should in some way protect them from such attacks. Owing to a contest with a French company they had had to reduce their tariff; but still there were no reasons for despondency as to the future. In the last year a cable had been successfully laid, and that and the other two cables were in admirable order. Lord Monck then moved the adoption of the report. Mr. Robert Grimston seconded the motion; to which an amendment was proposed to the effect that the dividends be paid, and that the directors be indemnified from personal liability. The amendment, however, was not agreed to; and the report having been approved, the usual votes of thanks concluded the meeting.

THE INDIA-RUBBER, GUTTA-PERCHA, AND TELEGRAPH WORKS COMPANY (LIMITED).—The directors' report for the year ending December 31st, 1880, states that the net profit on the Company's business for the past year, as shown in the accounts, is £67,227 19s. 9d. Adding £4,278 3s. 11d. brought forward from 1879, and £774 profit on securities realised, and deducting £15,600 interim dividend paid in August, there remains a disposable balance of £56,680 3s. 8d. Of this balance the directors have added £25,000 to the reserve fund, raising it to £75,000; and they recommend the distribution of £23,400 in dividend for the last half-year, being at the rate of 15 per cent. per annum, free of income tax, carrying forward £8,280 3s. 8d. to the credit of the current year. The past year's sales, both in general manufactures and in the cable department, have considerably exceeded those of 1879. A contract with the Mexican Telegraph Company of New York for the manufacture and laying of 525 miles of cable is in course of execution. Mr. Henderson, who retires by rotation, offers himself for re-election as a director.

At the meeting held at the City Terminus Hotel on February 9th, under the presidency of Mr. George Henderson, the chairman, in moving the adoption of the report, said that the general business had so materially increased that new buildings had had to be erected at Silvertown and additions made to the machinery, but no expense had been incurred which had not been absolutely essential. The *Dacia* and *International* were at present employed in laying cables in the Gulf of Mexico, and the shareholders would be glad to hear that they had already successfully accomplished more than half their work. After the accounts had been passed a suggestion would be made that for the present year, subject to revision by the shareholders in general meeting, the directors' remuneration should be £2,000 per annum; and that whenever the shareholders received a dividend of not less than 10 per cent. the directors should be entitled to an additional remuneration of 10 per cent. on any profits earned in excess of the sum required for payment of the 10 per cent. dividend, but in no case should their remuneration exceed the sum of £5,000. The resolution adopting the report and declaring a dividend at the rate of 15 cent. per annum, free of income tax, was then carried unanimously. On the motion of Mr. Hanson, seconded by Mr. Horne, it was resolved that the remuneration of the directors should be fixed as suggested in the chairman's speech. Among the other business transacted was the re-election of Mr. George Henderson as one of the directors, and the re-election of the auditors, Messrs. J. Weise and James Cowen; whilst expression was given to the satisfaction of the shareholders at the prosperous condition of the Company's affairs, by passing special votes of thanks to the chairman, to the directors, to Mr. Gray (the manager), and the officials of the Company.

COMPAGNIE DE TÉLÉGRAPHIE SOUS-MARINE DE L'AMÉRIQUE CENTRALE.—This Company has been formed, with a capital of £120,000 in £20 shares, the prospectus states, to connect all Central America with the United States and Europe, by means of a cable (with its tributary land lines) to be laid from Belize (British Honduras) to the Spanish Island of Cuba.

SIR JAMES CARMICHAEL, the chairman of the Submarine Telegraph Company is, we notice, one of the provisional directors; also, that the probable dividend to shareholders is *estimated* at 25 per cent.

THE BRAZILIAN SUBMARINE TELEGRAPH COMPANY having ascertained that messages for South America suffer a delay of two or three days in passing through Spain and Portugal, inform senders that telegrams can be directed *via* Malta, Bona, and Gibraltar, whereby the delay is avoided. The additional charge by this route is 10d. per word.

MR. HENRY COOKE has retired from the board, and Mr. D. H. Goodsall has joined the direction of the Western and Brazilian Telegraph Company (Limited).

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY notify the interruption of their Rio Grande do Sul, Monte Video section.

The following are the final quotations of telegraphs for the 11th inst.:—Anglo-American, Limited, 59¼-59¾; Ditto, Preferred, 87⅛-88½; Ditto, Deferred, 31⅛-32; Black Sea, Limited,——; Brazilian Submarine, Limited, 9⅞-10⅛; Cuba, Limited, 8⅛-9; Cuba, Limited, 10 per cent. Preference, 16-16½; Direct Spanish, Limited, 3-3⅛; Direct Spanish, 10 per cent. Preference, 13-13½; Direct United States Cable, Limited, 1877, 10⅞-11⅛; Scrip of Debentures, 101-103; Eastern, Limited, 9⅛-9⅝; Eastern 6 per cent. Preference, 12¼-12½; Eastern, 6 per cent. Debentures, repayable October, 1883, 102-106; Eastern 5 per cent. Debentures, repayable August, 1887, 100-103; Eastern, 5 per cent., repayable Aug., 1899, 101-104; Eastern Extension, Australasian and China, Limited, 10-10¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 107-110; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 104-106; Ditto, registered, repayable 1900, 104-106; Ditto, 5 per cent. Debenture, 1890, 102-104; Eastern and South African, Limited, 5 per cent. Mortgage Debentures, redeemable 1900, 101-103; Ditto, ditto, to bearer, 101-103; German Union Telegraph and Trust, 9⅛-10¼; Globe Telegraph and Trust, Limited, 6⅛-6⅛; Globe, 6 per cent. Preference, 12-12½; Great Northern, 10⅞-11⅛; 5 per cent. Debentures, 102-105; Indo-European, Limited, 26½-27½; London Platino-Brazilian, Limited, 5⅛-6; Mediterranean Extension, Limited, 2¼-3¼; Mediterranean Extension, 8 per cent. Preference, 10⅞-11⅛; Reuter's Limited, 10⅞-11⅛; Submarine, 267-272; Submarine Scrip, 2¼-2⅝; Submarine Cables Trust, 99-102; West Coast of America, Limited, 4-4½; West India and Panama, Limited, 1⅛-1⅜; Ditto, 6 per cent. First Preference, 6⅛-7; Ditto, ditto, Second Preference, 5⅛-6; Western and Brazilian, Limited, 7⅛-8; Ditto, 6 per cent. Debentures "A," 103-107; Ditto, ditto, ditto, "B," 98-102; Western Union of U. S. 7 per cent., 1 Mortgage (Building) Bonds, 122-127; Ditto, 6 per cent. Sterling Bonds, 104-107; Telegraph Construction and Maintenance, Limited, 36½-37; Ditto, 6 per cent. Bonds, 104-107; Ditto, Second Bonus Trust Certificates, 3⅛-3⅜; India Rubber Company, 18¼-19; Ditto, 6 per cent. Debenture, 107-109.